GRANULAR AGGREGATE RESOURCES, GRAND MANAN ISLAND (NTS 21 B/10) and CAMPOBELLO ISLAND (NTS 21 B/15, B/14) MAP AREAS, NEW BRUNSWICK

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GRANULAR AGGREGATE RESOURCES,

GRAND MANAN ISLAND (NTS 21 B/10) and

CAMPOBELLO ISLAND (NTS 21 B/15, B/14) MAP AREAS, NEW BRUNSWICK

Minerals and Energy Division

Department of Natural Resources and Energy

New Brunswick

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ABSTRACT

The Campobello Island and Grand Manan Island map areas contain workable reserves of granular aggregate materials estimated to exceed 12.5 million m^3. The distribution of these reserves among the three major islands in the area is as follows: Deer Island, 1%; Campobello Island, 56%; and Grand Manan Island, 43%. Approximately 50% of the reserves on Campobello Island lie within Roosevelt Campobello International Park, and 25% within Campobello Provincial Park, and are unlikely to be available for extraction except for park use.

The aggregate materials vary from poor to good in quality. All of the material on Deer Island is fine aggregate. Coarse aggregate comprises approximately half of the material on Campobello Island, and almost all of the material on Grand Manan Island.

RÉSUMÉ

Les régions cartographiques de l'île Campobello et de l'île Grand Manan contiennent des réserves exploitables d'agrégats granulaires estimées à plus de 12,5 millions m^3. Voici la répartition de ces réserves sur les trois principales îles de la région: île Deer, 1%; île Campobello, 56%; et île Grand Manan, 43%. Environ 50% des réserves de l'île Campobello se trouvent à l'intérieur des limites du parc international Roosevelt Campobello et 25% dans les limites du parc provincial Campobello. Ces réserves ne pourraient donc que difficilement être extraites, sauf peut-être pour utilisation dans le parc même.

La qualité des agrégats granulaires va de pauvre à bonne. Tous les agrégats de l'île Deer ont une granulométrie fine. Environ la moitié des agrégats de l'île Campobello et la presque totalité de ceux de l'île Grand Manan sont d'une granulométrie grossière.

INTRODUCTION

LOCATION AND ACCESS

The Grand Manan Island (21 B/10) and Campobello Island (21 B/15, B/14) map areas comprise the southernmost land areas of New Brunswick (Figure 1). They contain most of a small archipelago, the Fundy Isles, that lies adjacent to the State of Maine near the entrance to the Bay of Fundy. There are three major islands in this archipelago: from north to south they are Deer, Campobello, and Grand Manan (Figure 2). These islands have land areas of approximately 25 km^2 (within the study area), 38 km^2, and 140 km^2, respectively.

Access to Campobello Island is via a bridge from the United States and, during the summer, by a ferry from Deer Island. Deer Island and Grand Manan Island are accessible only by ferries from the mainland. Another ferry connects White Head Island and Grand Manan Island. Each island is traversed by a Provincial secondary highway, to which a number of local roads are connected. All of the significant granular aggregate deposits on these islands are readily accessible.

PREVIOUS WORK IN THE AREA

Aspects of the surficial geology of the Fundy Isles area were described by Mathew (1879) and Chalmers (1890) in their early works on the surficial geology of southern New Brunswick. Further information for parts of the area were subsequently provided by Alcock (1948c), Cederstrom (1975), and Legget (1980).

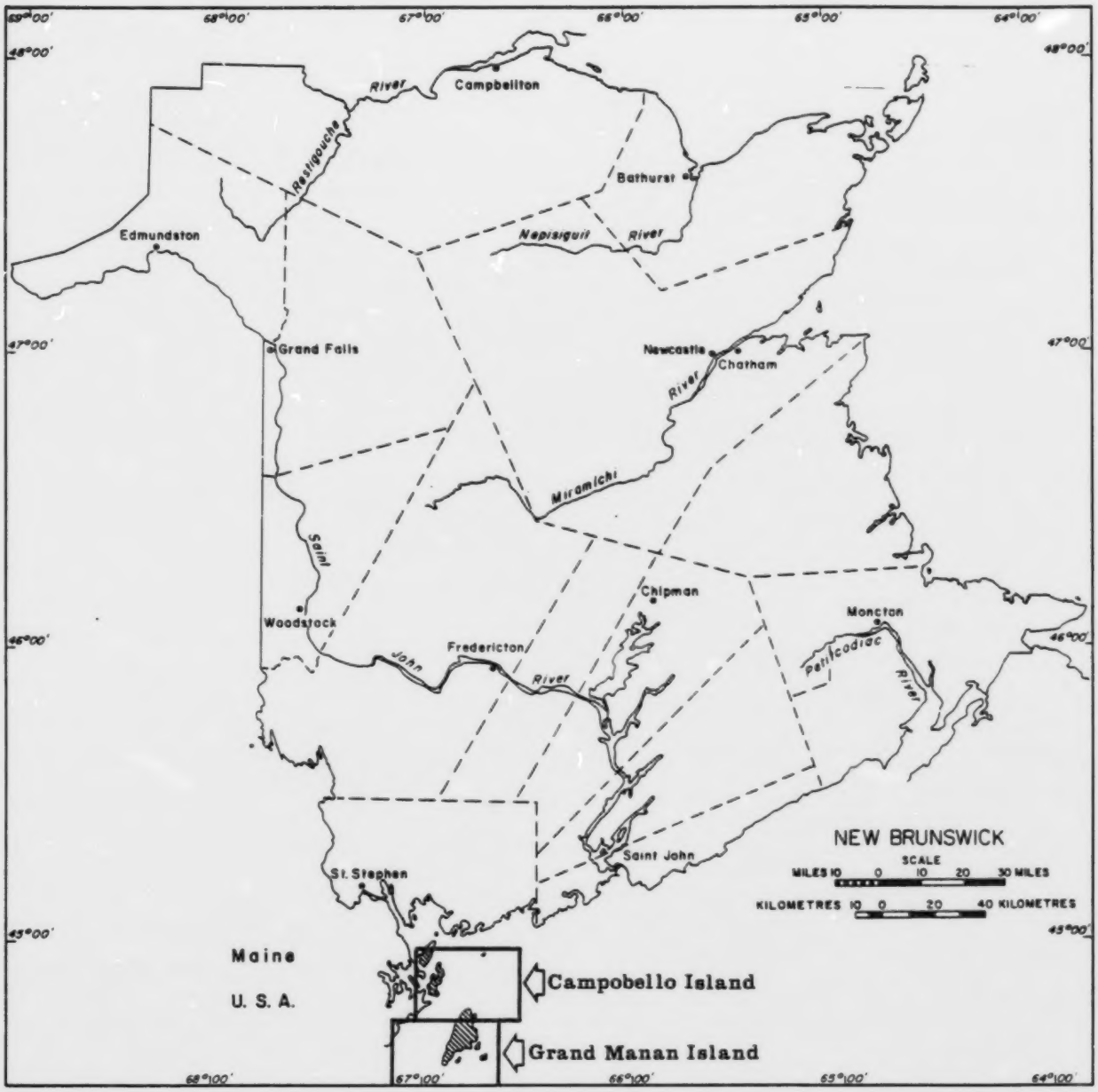


FIGURE 1. Location of the Grand Manan Island (21 B/10) and Campobello Island (21 B/15, B/14) map areas.

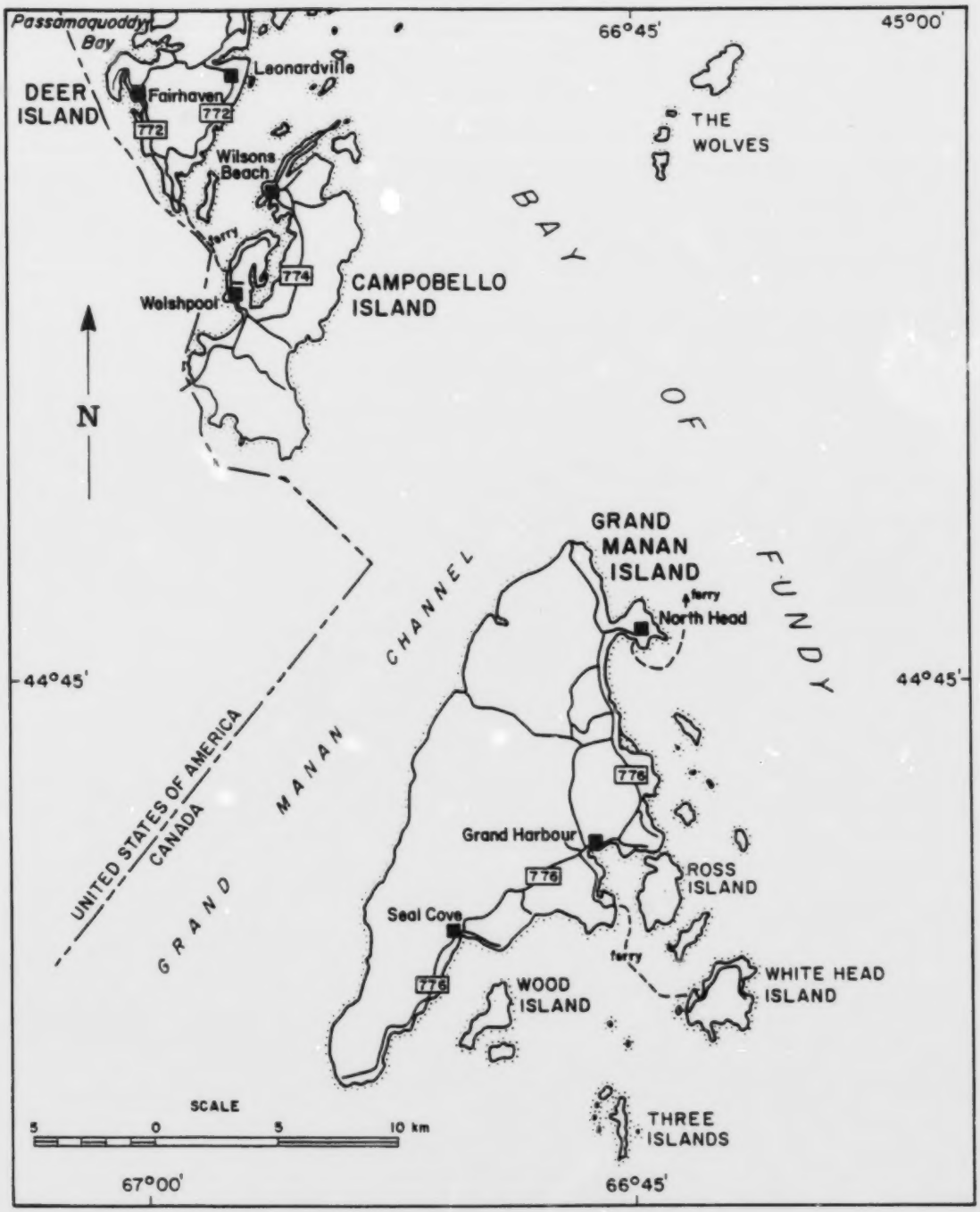


FIGURE 2. The Fundy Islands: location and access.

In addition, the village of North Head on Grand Manan Island has been mapped in detail (Ruitenberg and McCutcheon 1983), as has the coastal 1 to 2 km of land flanking the Bay of Fundy (Hunter and Associates 1982). The soils of the area, with associated information on surficial geology, were described by Wicklund and Langmaid (1953). The results of the above studies have been compiled and summarized by Rampton et al. (1984).

Information on a few of the aggregate extraction sites in the area was provided by Hamilton and Carroll (1975) and by the International Passamaquoddy Engineering Board (1959). In addition, Keys (1986) has prepared a preliminary aerial photograph evaluation of the granular aggregate resource potential in Roosevelt Campobello International Park.

The bedrock geology of the area was mapped by Alcock (1948a, b), who also made a few comments pertaining to the surficial geology. Subsequently, Cumming (1967) and Ruitenberg (1968) have studied the bedrock geology of parts of the area in greater detail.

THE PRESENT STUDY

The objective of this study is to provide basic information pertaining to the location, extent, thickness, and quality characteristics of the granular aggregate deposits on the Fundy Islands in southwestern New Brunswick. It is part of a province-wide inventory of granular aggregate resources.

Field work was carried out during three weeks in the summer of 1986. All drivable roads were surveyed, and all known

accessible aggregate extraction sites were examined and described. Samples for textural and lithologic analysis were obtained from representative sites.

The granular aggregate deposits and site locations are plotted on the accompanying maps (Plate 87-4, Campobello Island; Plate 87-5, Grand Manan Island). Detailed descriptions of the sampled sites are contained in the Appendices. These descriptions are accompanied by the sample analyses for these locations, available test data from the New Brunswick Department of Transportation (DOT), general comments pertaining to the deposits as a whole, and estimates of the workable reserves. Supplementary observations relating to other sites or deposits of interest are also included.

ACKNOWLEDGEMENTS

Capable field assistance was provided by Christina L. McLellan, who also performed the pebble lithology analyses. The samples for textural analysis were processed by ADI Limited of Fredericton. The report was typed by Diane Blair. The figures were drafted by Gerry Johnson, and the map by Vanderklift Exploration Services. The report, map, and figures were edited by Shasta A. Abbott.

Special thanks are extended to Mr. Henry W. Stevens, Superintendent of Roosevelt Campobello International Park, for permission to conduct field work within the park, and for access to an unpublished preliminary report (Keys 1986) on the granular aggregate resources of the park.

PHYSIOGRAPHY AND GEOLOGY

PHYSIOGRAPHY

The Fundy Isles lie within the St. Croix Highlands physiographic unit (Rampton et al. 1984). Deer Island and the northern part of Campobello Island are hilly, with relief of up to 90 m, and coastal cliffs from 20 to 50 m in height, while the southern part of Campobello Island is low, with only moderate relief (Cederstrom 1975; Rampton et al. 1984). Grand Manan Island also exhibits two distinct surface regions. Its western two-thirds comprises an eastward-dipping, elevated plateau (Bailey 1871). The western margin of the plateau is a steep cliff face 50 to 100 m high; the eastern margin is a scarp 20 to 30 m high (Rampton et al. 1984). The eastern third of the island is a lowland characterized by an irregular outline flanked by numerous small islands (Bailey 1871).

BEDROCK GEOLOGY

Deer Island and Campobello Island are underlain primarily by mafic to felsic extrusives, with some mafic intrusions and belts of metasedimentary rocks (Alcock 1948a). Similar rocks underlie parts of eastern Grand Manan Island and many of the adjoining islands (Potter 1968). Most of the eastern third of Grand Manan Island is underlain by metasedimentary rocks, while the western two-thirds is underlain by mafic extrusive rocks (Alcock 1948b).

The distribution of the major rock types in the Fundy

Islands is outlined in Figure 3. Further details concerning the bedrock geology of the area can be obtained from Alcock (1948a, b), and from Cumming (1967) and Ruitenberg (1968), and references therein.

SURFICIAL GEOLOGY

Surficial Materials: Most of the area is blanketed by a thin veneer of till (International Passamaquoddy Engineering Board 1959; Legget 1980). However, Legget (1980) has reported local occurrences of thick till on Grand Manan Island, while a thick till section has been observed on the southern coast of Campobello Island (see: B15-107). In many areas, the bedrock surface protrudes through the till. Locally, the bedrock is deeply weathered (Chalmers 1890; Legget 1980).

The eastern lowland of Grand Manan Island is largely blanketed by a thin sand and gravel deposit. Thicker deposits are encountered in reentrants into the adjacent bedrock scarp. The latter deposits are assumed to be glaciofluvial outwash deltas, while the former are interpreted to be marine shallow-water deposits, formed by the reworking of pre-existing deposits by wave action. There is no sharp boundary between the two deposit types. The marine shallow-water deposits may also include fluvial sediments deposited during the period of falling sea level.

A major kame moraine, and associated deposits, traverses the major axis of Campobello Island. The sedimentary character of this moraine suggests that it was formed at the interface

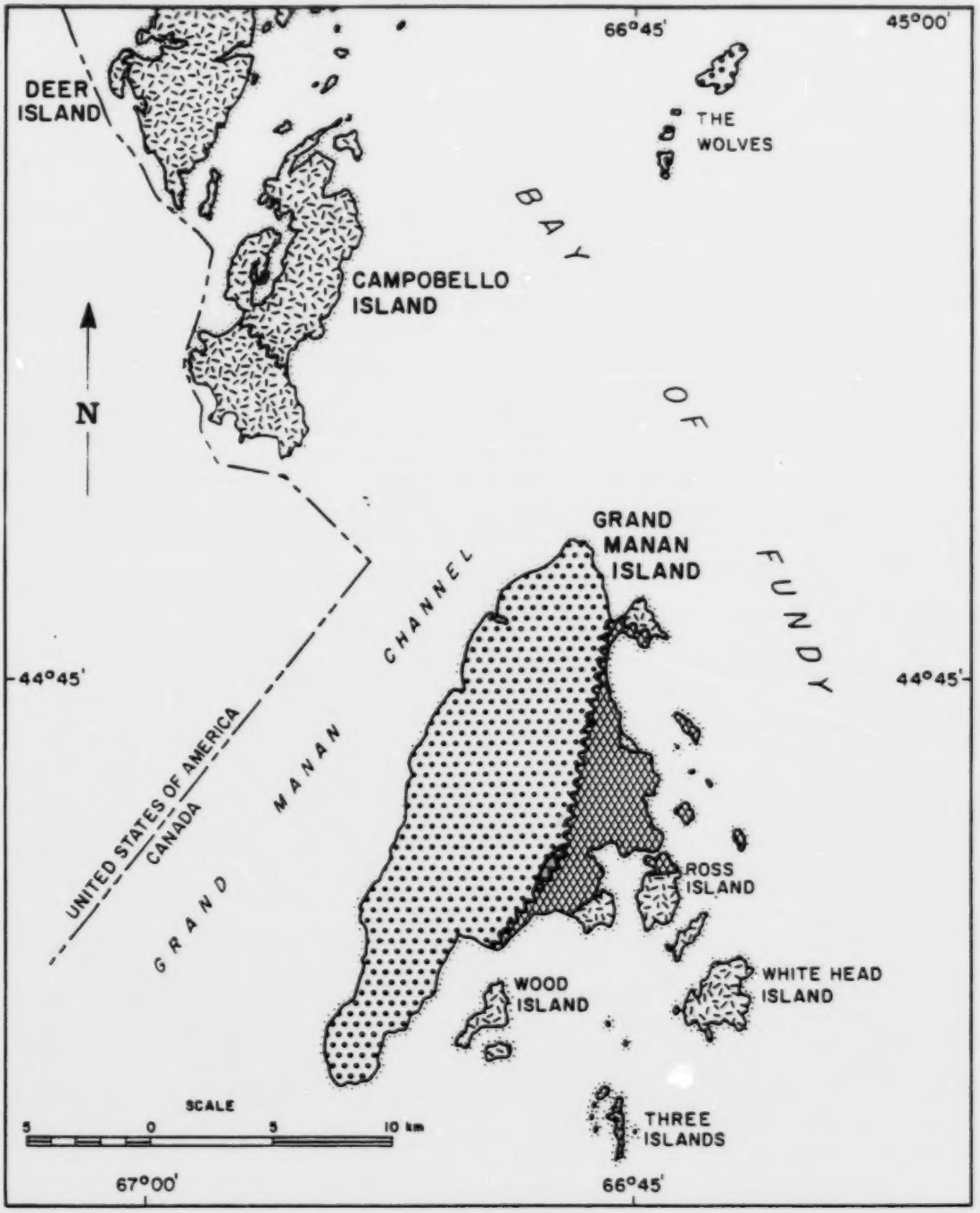
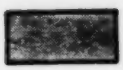


FIGURE 3. Bedrock geology of the Fundy Islands (from Alcock 1948a, b; Potter 1968).

LEGEND

TRIASSIC

mafic extrusive rocks - basalt



sedimentary rocks - conglomerate and sandstone

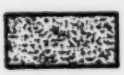
DEVONIAN (?)

felsic intrusive rocks

SILURIAN

mafic to felsic extrusive rocks - rhyolite, andesite, and basalt - with areas of mafic intrusive rocks - diabase and gabbro - and metasedimentary rocks

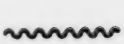
PRECAMBRIAN



felsic intrusive rocks - granite

metasedimentary rocks - quartzite, argillite, schist, and limestone

SYMBOLS



fault

between the glacier and an elevated sea.

Glacial History: Evidence throughout the area indicates that the Fundy Islands were heavily glaciated (Alcock 1948a, b, c; Cederstrom 1975; Chalmers 1890; Legget 1980; Mathew 1879). Numerous striated outcrops have been observed, with striae orientations ranging from eastward to southward. Many boulders, derived from the mainland to the north and west, are also evident (Alcock 1948b, c; Legget 1980; Mathew 1879).

The chronology of glaciation is unclear. Alcock (1948b) interpreted the striae interrelationships to indicate that there were three main ice flow events: eastward, southeastward, and finally, southward. In contrast, Gadd (1973), in his work on the mainland immediately to the north, interprets the eastward flow as latest, due to the persistence of a lobe of ice in the Passamaquoddy Bay area. Further investigations will be required to resolve this discrepancy.

Rampton et al. (1984) suggest that Grand Manan Island may not have been glaciated since some time prior to 14 000 yBP. However, the soils developed on the surficial deposits of the island do not appear to be significantly different in depth or character from soils on similar deposits on the mainland, and thus should not be significantly older. The pattern of outwash sediments on Grand Manan Island indicates that their source lay to the west. However, there are no apparent ice-marginal positions on the island. It is suggested that the Late Wisconsinan ice, from a mainland source to the northwest, retreated across the island, probably under the influence of

rising sea levels, and established its margin along the cliffs that form the western edge of the island. This margin is tentatively correlated with the oldest (Sheldon Point) moraine at Saint John, assigned a date of 13 400 yBP by Rampton et al. (1984). Shells from Red Point, dated at 13 000 yBP (Legget 1980), provide the approximate age for the shallow-water marine deposits.

Rampton et al. (1984) indicate that the ice margin had retreated to the Campobello Island kame moraine by 13 200 yBP and remained here for about 200 years. This moraine is probably correlative with the second (Manawagonish) moraine at Saint John, and with the delta complex to the east of Saint George. The Fundy Islands were completely deglaciated by 12 900 yBP (Rampton et al. 1984).

Subsequent to deglaciation, the area probably remained submerged to levels above present until at least 11 000 yBP, based on a new shell date at Saint John (11 620±250 yBP; BGS 1223; 37 metres a.m.s.l.). The sea level eventually fell to a minimum well below current level by about 8500 yBP (Schnitker 1974). It has been rising again for at least the last 4000 years (Grant 1970).

GRANULAR AGGREGATE RESOURCES

QUALITY

Analysis: The quality of an aggregate material is dependent upon two primary physical characteristics:

1) the grain-size characteristics of the material, and

2) the lithologies of its component clasts.

Grain-Size Characteristics: The grain-size characteristics of an aggregate are determined by passing a sample of the material through a nest of sieves (A.S.T.M. C136-76) and they apply specifically to the sample examined. Therefore, an attempt was made when collecting the samples to obtain those that were representative of the material in the observed sections. Samples weighing approximately 5 to 50 kg were obtained, the size of the sample being determined by the percentage of gravel in the material and its coarseness. Analysis of the samples was carried out using wet sieve analysis (A.S.T.M. C117-76) to accurately determine the fines (silt and clay) content. The results of these mechanical analyses are tabulated in the Appendices.

The grain-size characteristics of the material were also estimated in the field, on a qualitative basis, using the standard geological grain-size classification outlined in Table I. The relative proportions of the major grain-size classes within the materials are described in terms of the textural classification outlined in Table II. In addition, the terms

TABLE I

GRAIN-SIZE CLASSIFICATION
(Classification modified after Friedman and Sanders 1978)

Descriptive Size Category	Limiting Size (Minimum)	Approximate Equivalent In DOT Sieve Sizes (Not Passing)
Boulders	256 mm	-
Cobbles		
- large	128 mm	-
- small	64 mm	75 mm
Gravel		
- very coarse	32 mm	31.5 mm
- coarse	16 mm	19.0 mm
- medium	8 mm	9.5 mm
- fine	4 mm	4.75 mm
- very fine	2 mm	2.36 mm
Sand		
- very coarse	1 mm	1.18 mm
- coarse	500 um	600 um
- medium	250 um	300 um
- fine	125 um	150 um
- very fine	63 um	75 um
Silt and Clay (fines)	-	-

TABLE II

TEXTURAL CLASSIFICATION
(Modified from Folk 1968)

	% Passing 2.35 mm (Approximate Range)
Gravel	0 - 20
Sandy Gravel	20 - 70
Gravelly Sand	70 - 95
Sand	95 - 100

	% Passing 75 um (Approximate)
Silty	10+
Slightly Silty	5 - 10

"fine aggregate" and "coarse aggregate" are used to identify material predominantly finer and predominantly coarser, respectively, than 4.75 mm (A.S.T.M. C125-76).

Lithologic Characteristics: The composition of the clasts within an aggregate deposit has a significant effect on the quality of the material. Preferably, clasts should exhibit three primary characteristics: a) they should be of good physical quality, b) they should be uncoated, and c) they should not react with any cementing materials.

To determine the lithologic characteristics of a deposit, a sample of 50 to 100 pebbles in the 25 to 50 mm size range was collected from a fresh exposure. The lithologies represented by the clasts were determined, and they were divided into two groups, sound and unsound. The two groups are differentiated primarily on the basis of the resistance of the clasts to disintegration under mechanical impact (with the exception of chert, which is classed as unsound due to its known chemical instability in concrete). The results of this test should not be confused with those from quantitative soundness tests (e.g., the sodium or magnesium sulphate tests), or those from abrasion tests (e.g., the Los Angeles abrasion loss test).

The results of the above qualitative soundness tests, plus any quantitative test results available from DOT, are tabulated in the Appendices.

Limitations: There are five major factors that serve to degrade the quality of an aggregate: two relate to texture, and three to clast lithology. These are: 1) an excessive fine

particle content; 2) poor grading; 3) poor physical quality of clasts; 4) coatings on clasts; and 5) reactive character of clasts (i.e., alkali-reactivity in cement).

Fine Particle Content: A content of fine particulate matter (that material passing through a 75 um sieve) in excess of 5% in an aggregate is generally considered deleterious. For some usages, even lower percentages are specified (Bates 1969).

Fine particles may occur as discrete beds within a deposit, as coatings on larger clasts, as disseminated particles throughout a deposit, or as some combination of the above. If an aggregate contains fines in excess of the specified limits for a particular use, it may be upgraded to an acceptable level by washing, with an attendant significant increase in the cost of exploitation. However, in the first case above, this may be avoided by selective extraction of material.

Grading: Grading refers to the particle size distribution within the aggregate (i.e., the relative proportions of material in the different size categories). The natural grading of a deposit may be improved by crushing, by selective screening and recombination, or by the combination of materials from different sources or areas. However, such processing increases production costs. Excessive variability in the grading of a deposit can also lead to production problems.

Grading limits are specified by users (e.g., DOT), and will vary, depending upon the proposed use of the material. Poor grading may restrict the potential of some deposits for certain uses.

Physical Quality: Ideally, clasts should be hard, strong and durable. Soft materials such as shale, schist, and friable sandstones are unsuitable for use in most aggregates, since they disintegrate easily, while porous or fractured rock fragments may split due to the expansion of water as it freezes (Bates 1969). Poor physical quality may be a significant quality limiting factor in some of the deposits in the study area.

Clast Coatings: The presence of silt, clay, carbonate, or oxide coatings on clasts renders them unsuitable for use in high-specification aggregate, since they weaken the bond between the clast and the cementing agent, and in concrete may become chemically unstable (Bates 1969). Silt and clay coatings may be removed by washing, with a consequent increase in the cost of exploitation. Coatings of this type are prevalent on clasts in deposits with high fine particle contents, but may also be found in other deposits.

Alkali-reactivity: Clasts that contain opaline or cryptocrystalline silica react with the alkalies in cement. As a result of this reaction, the clasts expand, producing cracks within the concrete that make it susceptible to freeze-thaw and other destructive processes. The primary offenders have been considered to be chert and some felsic extrusive rocks (Bates 1969). However, other rocks, such as schists, quartzites, greywackes, argillites, and phyllites have been shown to cause problems (Swenson 1973). In cases of suspected reactivity, the use of low-alkali portland cement or partial substitution of a

pozzolanic material - such as fly-ash or finely ground siliceous material - for some of the cement is recommended (Bates 1969; Swenson 1973).

In the study area, the content of potentially reactive clasts is moderate to high in most deposits. Until proven otherwise, it would be safest to assume that these materials are reactive.

DESCRIPTION OF MAP UNITS

The major granular aggregate resources of the study area are found in deposits of three basic types. These are: 1) ice-contact stratified drift; 2) glaciofluvial outwash and outwash deltas; and 3) shallow-water marine deposits. A general description of each of these deposit types is given below.

Ice-contact Stratified Drift: Ice-contact stratified drift deposits are those deposits of glaciofluvial origin that are formed of sediment deposited by meltwater on or against glacial ice. Characteristically, such deposits form distinctive constructional landforms.

The major ice-contact deposit in the Fundy Isles is the Campobello kame moraine. Kame moraines are ridges of glaciofluvial material that were deposited against the frontal margins of glaciers (Sugden and John 1976). Several related features of indeterminate, but presumed ice-contact, origin are also present on Campobello Island.

In general, ice-contact stratified drift deposits consist

primarily of sand or gravel, with variable quantities of fines, cobbles, and boulders. The sorting can vary from very poor to good, while the texture commonly exhibits abrupt lateral and vertical variations - sometimes due to postdepositional deformation as a result of slumping subsequent to the withdrawal of the supporting glacier ice. Because of their close association with the glacier, pockets of ablation or lodgement till may be present.

Glaciofluvial Outwash: Glaciofluvial outwash comprises the sediment that is deposited beyond the margins of a glacier by the action of meltwater streams. In general, this material consists of well-washed, horizontally stratified sand or gravel. These deposits usually exhibit a flat, gently sloping topography (Flint 1971).

Where meltwater streams discharge into bodies of standing water, outwash deltas are formed. These deposits consist of a topset unit of glaciofluvial outwash, typically one to several metres thick, overlying steep-dipping foreset beds. The foreset beds are usually finer grained than the topset beds, and often consist primarily of fine aggregate, sometimes silty.

Shallow-Water Marine Deposits: Shallow-water marine deposits were generated by the action of waves in coastal areas during the interval of late-glacial submergence. These deposits occur as blankets of well-washed sand and gravel over the underlying till or bedrock surface.

In the study area, these deposits range from less than 1 m to 6 m in thickness. However, their typical thickness is 1 to 2 m.

GRANULAR AGGREGATE SOURCES

Deer Island: Workable reserves of granular aggregate material on Deer Island are estimated to be about 150 000 m^3. This material, all fine aggregate, is found in the outwash and marine shallow-water deposits at Cummings Cove.

Campobello Island: Workable reserves of granular aggregate material on Campobello Island are estimated at about 7 million m^3. This material is approximately half fine aggregate and half coarse aggregate. Approximately 6 million m^3 of the total amount of material lies in the Campobello kame moraine, that extends from Mulholland Point to Barrow Well Hill, on the southern half of the island (B15-5, 6, 103, 104, 105). A further 0.7 million m^3 of material is present in a smaller, wave-reworked, moraine to the southeast, that extends from Lower Duck Pond to Herring Cove (B15-7, 106). The remaining material is found in smaller ice-contact deposits, on the hilly, northern half of the island, that appear to be related to the Campobello kame moraine. Approximately 75% of the reserves on Campobello Island lie within the island's parks: 50% in Roosevelt Campobello International Park, and 25% in Campobello Provincial Park. It is unlikely that such materials would be available for use outside of the park areas.

Grand Manan Island: Grand Manan Island contains an estimated 5.5 million m^3 of granular aggregate material. Coarse aggregate comprises the bulk of the material. Most of the material (4.8 million m^3) lies in the marine shallow-water deposits that extend from Red Point north to Castalia (B10-4, 7, 8). While reserves in this deposit are large, major production

from this deposit is unlikely, since the deposit is extensive but thin (1 m average workable thickness). The remaining reserves on the island are found in small outwash deposits, some of which inosculate with the marine deposits, or in other small areas of marine shallow-water material.

CONCLUSIONS

The Fundy Islands contain estimated workable reserves of granular aggregate material in excess of 12.5 million m^3. Of this amount, 1% occurs on Deer Island; 56% on Campobello Island; and 43% on Grand Manan Island.

All of the material on Deer Island is fine aggregate. Most of it is of good quality.

The material on Campobello Island is approximately half fine aggregate and half coarse aggregate. The quality is locally poor, but generally fair to good. Three-quarters of the material lies within Roosevelt Campobello International and Campobello Provincial parks. This material will not be readily available for exploitation.

The material on Grand Manan Island is almost all coarse aggregate. It is generally of poor to fair quality, though good quality material for asphaltic concrete use is locally available. Full exploitation of the aggregate resources on Grand Manan would be difficult, due to the occurrence of almost 90% of the reserves in thin, areally extensive, marine shallow-water deposits.

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APPENDIX A

SITE DESCRIPTIONS

DEER ISLAND

21 B/14, B/15

LOCATION:	B14-1	**NTS:**	21 B/14
TYPE OF DEPOSIT:	Marine shallow-water	**COUNTY:**	Charlotte
EXPOSURE TYPE:	Pit	**PARISH:**	West Isles
STATUS:	Abandoned	**UTM:**	562 813

SECTION DESCRIPTION & COMMENTS:

0.6 m Soil: Silty soil, developed in a fine to medium sand.

1.2 m Sand: The upper half of this unit comprises cross-bedded (southward-dipping) medium to coarse sand with gravelly bands; the lower half consists of well-sorted medium sand; the few clasts present are subangular to subrounded, with a maximum size of 15 cm.

2.0 m Slump Covered: Assumed to be material as above.

The thickness of the material in this tiny pit is highly variable. In one part of the pit, bedrock is exposed extending upward almost to the surface of the deposit.

The International Passamaquoddy Engineering Board (1959) estimated total reserves in this deposit to be about 300 000 m^3. Given the irregularity of the bedrock surface, this estimate seems excessive. Due to the local shallow depths to bedrock, and to the presence of a cemetery on the centre of the deposit, workable reserves are considered to be limited.

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.		100.0	97.6	95.2	91.8	86.8	76.4	47.4	10.6	2.3	1.3

LITHOLOGIC ANALYSIS: N.A.

Unsound Lithotypes	%	Sound Lithotypes	%

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
			Limited

LOCATION:	B14-2	**NTS:**	21 B/14
TYPE OF DEPOSIT:	Glaciofluvial outwash	**COUNTY:**	Charlotte
EXPOSURE TYPE:	Pit	**PARISH:**	West Isles
STATUS:	Active-on-demand	**UTM:**	577 792

SECTION DESCRIPTION & COMMENTS:

North Face

0.5 m Soil: Silty soil, developed on the underlying material; slightly gravelly.

3.7 m Sand: Cross-bedded (eastward-dipping) fine to coarse sand.

0.8 m Slump Covered: Assumed to be material as above.

At the southern end of the pit, the sand is overlain by approximately 1 m of cross-bedded sandy gravel and gravelly sand. The clasts in this unit are subangular to rounded. Striated bedrock is exposed at the base of the pit in this area, beneath about 2 to 3 m of material. A few erratics up to 0.6 m in size are present in the pit area.

This pit is the newest in a series of pits in a large pit complex. The older pits, now inactive to abandoned, expose from 2 to 8 m of sand or gravelly sand, locally with silty beds. The southernmost pit is underlain by marine clay.

DOT (1961, 1971) have test pitted extensively in this area, collecting 20 samples. The results of their tests were as follows:

(CONTINUED)

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.					100.0	98.9	90.0	55.6	18.1	4.2	1.5

LITHOLOGIC ANALYSIS: N.A.

Unsound Lithotypes	%	Sound Lithotypes	%

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)		Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
A	8	3	3	90 000
B	15	2	3	60 000

Location #: B14-2 (cont'd)

Mechanical Analysis:
72 to 100% passing 4.75 mm (average 93%)
1.2 to 35.3% passing 75 um (average 5.7%; 12 less than 3%)

Recommended for use as borrow, and, excluding the 2 very silty samples, as a possible source of blending, filter, and winter sand.

Eight boreholes, from 6.4 to 17.4 m deep, were reported from this deposit by the International Passamaquoddy Engineering Board (1959). Their drill logs indicate that the material is primarily sand, locally silty, with minor interbeds of silt or clay.

This deposit, the only known one of significance on Deer Island, is interpreted as a glaciofluvial outwash delta with flanking marine shallow-water deposits. The International Passamaquoddy Engineering Board (1959) estimated that reserves for this deposit were in the order of 750 000 m^3. However, the deposit has been extensively worked since that time, and remaining reserves are estimated to be only one-fifth of that amount. Reserve estimate A pertains to the higher, deltaic, part of the deposit, while estimate B pertains to the marine part.

B15-101 UTM 604 805

From the recent colour aerial photographs of the area, this small excavation, not visited due to lack of access, appears to be a long abandoned bedrock quarry with a small pit area adjacent. DOT (1961) described a small, shallow deposit in this area that was adjacent to bedrock. They took two samples, the test results for which were as follows: 40.8 and 47.5% passing 4.75 mm; 1.9 and 2.5% passing 75 um. Any reserves remaining would be very limited.

Most of Deer Island was submerged during deglaciation. Consequently, similar small deposits could be present elsewhere on the island. DOT (1978) has tested another such site, about 1 km south-southwest of that above. Most of the material was silt or clay, but 2 samples of sandy gravel were obtained. The test results on these were as follows:

Mechanical Analysis:
47 and 62% passing 4.75 mm
5.0 and 6.0% passing 75 um

Los Angeles abrasion loss: 22.7 and 23.1%

Recommended for use as borrow and subbase.

APPENDIX B

SITE DESCRIPTIONS

CAMPOBELLO ISLAND

21 B/15

LOCATION:	B15-1	**NTS:**	21 B/15
TYPE OF DEPOSIT:	Ice-contact(?)	**COUNTY:**	Charlotte
EXPOSURE TYPE:	Pit	**PARISH:**	Campobello
STATUS:	Active-on-demand	**UTM:**	655 764

SECTION DESCRIPTION & COMMENTS:

0.5 m Soil: Silty soil, developed on the underlying material.

1.5 m Sandy Gravel: Subhorizontally stratified medium to very coarse gravel and medium to very coarse sand, with a few cobbles; contains thin interbeds of coarse to very coarse sand, and of openwork gravel; clasts are subangular to rounded, with moderate silt coatings; maximum clast size is 0.6 m, but clasts exceeding 0.1 m in size are very rare.

Locally, bedrock or dense reddish brown till is present at the base of the pit. The deposit occurs as a thin veneer, up to 1.5 m thick, of indefinable extent. In many areas the water table is very close to the surface. The deposit is presumed to be of ice-contact origin, but could also be all, or in part, of marine origin, derived by reworking of till and ice-contact stratified drift. Its aggregate production potential is very limited.

MECHANICAL ANALYSIS:

sieve	50mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	89.8	63.6	55.3	40.5	34.0	27.4	18.1	11.6	6.0	3.9	3.0

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 37%	Sound Lithotypes 63%
mafic intrusive 10; weathered 10; felsic intrusive 3; schist 3; chert 2; shale 2; slate 2; mafic extrusive 1; sandstone 1; siltstone 1; metavolcanic 1; hornfels 1	mafic intrusive 24; quartzite 9; felsic intrusive 5; mafic extrusive 5; argillite 4; felsic extrusive 3; sandstone 3; greywacke 3; siltstone 2; metasedimentary 2; gneiss 1; hornfels 1; quartz 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
			Limited

LOCATION:	B15-2	**NTS:**	21 B/15
TYPE OF DEPOSIT:	Ice-contact	**COUNTY:**	Charlotte
EXPOSURE TYPE:	Pit	**PARISH:**	Campobello
STATUS:	Active	**UTM:**	650 757

SECTION DESCRIPTION & COMMENTS:

0.5 m Soil: Removed; thickness estimated.

1.1 m Cobbly Gravel: Very poorly sorted, slightly bouldery cobbly very fine to very coarse gravel, with a matrix of fine to very coarse sand.

3.4 m Sandy Gravel: Crudely stratified, poorly sorted, fine to very coarse gravel and fine to very coarse sand, locally slightly silty, with a few cobbles and large boulders; the sample was obtained from this unit.

1.0 m Slump Covered: Assumed to be material as above.

Clasts in this deposit are subangular to rounded, with light silt coatings. Clasts exceeding 0.1 m in size are estimated to comprise approximately 10% of the material. Maximum clast size is 1.8 m.

Eleven samples were obtained from the pit area by DOT (1972). The results of their analyses were as follows:

(CONTINUED)

MECHANICAL ANALYSIS:

sieve	50mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	74.4	55.0	50.5	41.7	35.1	29.1	23.3	17.0	9.0	2.6	1.3

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 27%	Sound Lithotypes 73%
weathered 6; shale 5; chert 4; schist 3; felsic intrusive 2; mafic extrusive 2; felsic extrusive 1; mafic intrusive 1; siltstone 1; metavolcanic 1; metasedimentary 1	felsic intrusive 19; mafic intrusive 10; quartzite 10; mafic extrusive 8; greywacke 6; metasedimentary 6; felsic extrusive 3; argillite 3; metavolcanic 3; sandstone 2; quartz 2; gneiss 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
28	10	2	200 000

Location #: B15-2 (cont'd)

Mechanical Analysis:
58 to 100% passing 50 mm (average 82%)
21 to 62% passing 4.75 mm (average 39%)
1.1 to 8.1% passing 75 um (average 3.3%)

Los Angeles abrasion loss: 19.9 to 20.6% (average 20.2%)

Recommended for use as borrow, subbase, and base-course aggregate, with the exception of the silty materials, which were considered suitable for use as borrow and borderline for use as pit-run subbase.

The boundaries of this deposit are poorly defined. Reserves could be significantly greater than estimated.

LOCATION:	B15-3	**NTS:**	21 B/15
TYPE OF DEPOSIT:	Ice-contact(?)	**COUNTY:**	Charlotte
EXPOSURE TYPE:	Pits	**PARISH:**	Campobello
STATUS:	Active-on-demand	**UTM:**	653 744(A) 653 742(B)

SECTION DESCRIPTION & COMMENTS:

Northern Pit (A)

0.6 m Soil: Slightly silty soil, developed on the underlying material.

1.3 m Gravel: Cross-bedded (northward-dipping), sandy to openwork fine to very coarse gravel with a few cobbles, similar to that at site B.

1.8 m Gravelly Sand: Subhorizontally stratified fine to very coarse sand and very fine to medium gravel, with minor beds of sandy gravel; Sample A was obtained from this unit.

1.1 m Slump Covered: Assumed to be material as above.

A small, subsidiary lift with slump-covered faces extends 3.4 m below the base of the above section. The material at its base is a gravelly fine to medium sand.

Southern Pit (B)

0.5 m Soil: Slightly silty soil, developed on the underlying material.

(CONTINUED)

MECHANICAL ANALYSIS:

sieve	50mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass. A	100.0	95.8	92.3	83.4	74.6	64.2	47.7	24.6	9.0	4.6	3.9
% pass. B	75.6	47.3	41.3	28.9	22.6	19.7	16.8	14.1	8.1	2.8	1.8

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 19%	Sound Lithotypes 81%
chert 5; schist 4; sandstone 3; felsic intrusive 2; weathered 2; mafic extrusive 1; shale 1; metasedimentary 1	mafic intrusive 17; quartzite 16; mafic extrusive 9; felsic extrusive 8; metasedimentary 8; felsic intrusive 5; argillite 5; greywacke 3; quartz 3; sandstone 2; metavolcanic 2; gneiss 2; siltstone 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
	2	5	100 000

Location #: B15-3 (cont'd)

3.1 m Sand and Gravel: Large-scale cross-bedded (westward-dipping) sandy gravel with interbeds of openwork gravel, and gravelly sand; the gravel beds vary from fine to medium through to cobbly coarse to very coarse; the sand component is predominantly fine to medium; Sample B was obtained from this section.

3.9 m Slump Covered: Assumed to be material as above.

Striated bedrock is exposed in the east face of this pit. The deposit surface slopes westward away from this bedrock high.

The clasts in these two pit areas are subangular to rounded, with light silt coatings. Maximum clast size is 0.6 m in pit A and 0.7 m in pit B. The content of clasts greater than 0.1 m in size is estimated at about 1%, and 2 to 5%, respectively.

The deposit in which these pits are developed is presumed to be of ice-contact origin. However, parts, or all of it, could alternatively be of marine origin. Its extent is indeterminate. However, it is estimated that there is 1 ha of workable material adjacent to each pit. Similar, as yet undiscovered, deposits could be present elsewhere on the island.

LOCATION:	B15-4	**NTS:**	21 B/15
TYPE OF DEPOSIT:	Ice-contact	**COUNTY:**	Charlotte
EXPOSURE TYPE:	Pit	**PARISH:**	Campobello
STATUS:	Active	**UTM:**	639 739

SECTION DESCRIPTION & COMMENTS:

Composite Section

0.6 m Soil: Silty soil, developed on the underlying material.

2.1 m Cobbly Gravel: Poorly sorted, horizontally stratified, cobbly medium to very coarse gravel, with a number of very large boulders up to 1.7 m in size; the matrix comprises variable gradations of sand or very fine to fine gravel.

12.3 m Sandy Gravel: Cross-bedded (southward-dipping) fine to very coarse gravel and medium to very coarse sand; contains some coarser sandy gravel beds, and minor openwork gravel beds and sand lenses; concentrations of cobbles and boulders are locally present; the sample is approximately representative of the bulk of the material in this unit.

Clasts in this deposit are subangular to rounded, with light to moderate silt coatings. Clasts exceeding 0.1 m in size are estimated to comprise 5 to 10% of the material.

DOT (1972, 1984, 1985) has obtained 1 sample of fine aggregate and 10 samples of coarse aggregate from the deposit. The results of the tests were as follows:

(CONTINUED)

MECHANICAL ANALYSIS:

sieve	50mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	71.9	60.8	55.9	45.0	35.5	28.1	20.8	14.2	8.6	4.0	1.9

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 38%	Sound Lithotypes 62%
sandstone 9; weathered 7; shale 6; siltstone 4; felsic intrusive 3; mafic intrusive 2; mafic extrusive 2; felsic extrusive 1; chert 1; metasedimentary 1; schist 1; slate 1	mafic intrusive 16; felsic intrusive 14; mafic extrusive 8; quartzite 6; metavolcanic 4; sandstone 3; greywacke 3; metasedimentary 3; gneiss 2; felsic extrusive 1; argillite 1; quartz 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
12	3	3	90 000

Location #: B15-4 (cont'd)

Pit Run Material

Mechanical Analysis - fine aggregate
82% passing 4.75 mm; 10.5% passing 75 um

- coarse aggregate
67 to 96% passing 50 mm (average 84%)
16 to 57% passing 4.75 mm (average 36%)
1.2 to 3.0% passing 75 um (average 2.1%)

Los Angeles abrasion loss: 16.4 to 20.7% (average 18.8%)

Crushed Material

Mechanical Analysis
34% passing 4.75 mm; 2.7% passing 75 um

Soundness Loss: stone - 4.10%; sand - 7.74%

The coarse aggregate was recommended for use as borrow, subbase, base-course, and asphaltic concrete aggregate; the fine aggregate for borrow, and as a possible source of blending and filter sand.

Reserves in this deposit are approaching depletion. Bedrock is exposed near the surface at the western end of the pit and near the base of the face in the middle of the pit. The outcrop is at the surface about 25 m to the north of the central part of the pit face.

An asphalt plant was active in the pit in June 1986.

LOCATION:	B15-5	**NTS:**	21 B/15
TYPE OF DEPOSIT:	Ice-contact (kame moraine)	**COUNTY:**	Charlotte
EXPOSURE TYPE:	Pit	**PARISH:**	Campobello
STATUS:	Active	**UTM:**	626 717

SECTION DESCRIPTION & COMMENTS:

Composite Section

0.6 m Soil: Slightly silty soil, developed on the underlying material.

0.7 m Sandy Gravel: Horizontally stratified very fine to medium gravel and fine to coarse sand; overlies a basal lag of large gravel clasts, cobbles, and a few boulders up to 1.1 m in size.

10.7 m Sand and Gravel: Large-scale trough cross-bedded units; the southern pit face exposes sandy gravel, overlying up to about 8 m of parallel-bedded and ripple cross-laminated fine to medium sand (Sample A); in the northern face, the sand is much thinner, and overlies sandy very fine to coarse gravel with lenses of openwork cobbly fine to very coarse gravel (Sample B); clasts are subrounded to well rounded, with light silt coatings; less than 1% of the material consists of clasts greater than 0.1 m in size.

Five fine aggregate samples and one coarse aggregate sample were obtained by DOT (1984) from the pit area. The results of the tests were as follows:

Mechanical Analysis - fine aggregate
70 to 100% passing 4.75 m (average 84%)
1.0 to 15.1% passing 75 um (average 7.8)

(CONTINUED)

MECHANICAL ANALYSIS:

sieve	50mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass. A			100.0	98.8	98.6	98.3	97.0	90.0	65.4	19.9	4.8
B	86.2	65.0	56.0	36.7	25.3	17.6	9.7	4.6	2.7	1.8	1.4

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 15%	Sound Lithotypes 85%
weathered 3; felsic intrusive 2; mafic intrusive 2; mafic extrusive 2; chert 2; shale 2; siltstone 1; slate 1	felsic intrusive 17; argillite 12; mafic extrusive 11; felsic extrusive 8; quartzite 8; sandstone 7; mafic intrusive 4; metasedimentary 4; hornfels 4; metavolcanic 3; gneiss 3; siltstone 2; greywacke 1; quartz 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
A	1	10	100 000
B	40	1.5	600 000

Location #: B15-5 (cont'd)

- coarse aggregate
94% passing 50 mm; 27% passing 4.75 mm; 1.3% passing 75 um

Los Angeles abrasion loss: 18.3%

Recommended for use as borrow, and possibly as a source of filter or blending material.

The International Passamaquoddy Engineering Board (1959) recorded the logs of four test holes, 5.8 to 15.3 m deep, bored in the pit area. The material was described as predominantly sand, locally silty, with a gravelly capping and local interbeds of silt or clay.

This pit is developed in the crest area of the large Campobello kame moraine (see also: B15-6, 103, 104, and 105). Most of the deposit in the pit area lies within Campobello Provincial Park. Workable reserves are estimated for the immediate pit area (estimate A), and for the area to the east of the golf course (estimate B; approximately half within the park boundaries). DOT (1980) testing in the latter area indicates that the material is generally fine, and that bedrock locally occurs within 1.5 m of the surface. Two samples were analysed. The results were as follows:

Mechanical Analysis:
60 and 96% passing 4.75 mm
0.6 and 0.8% passing 75 um

Los Angeles abrasion loss: 19.2%

LOCATION:	B15-6	**NTS:**	21 B/15
TYPE OF DEPOSIT:	Ice-contact (kame moraine)	**COUNTY:**	Charlotte
EXPOSURE TYPE:	Pit	**PARISH:**	Campobello
STATUS:	Active	**UTM:**	599 699

SECTION DESCRIPTION & COMMENTS:

0.5 m Soil: Silty soil, developed on the underlying material; partially removed; thickness estimated.

2.3 m Sandy Gravel: Horizontally stratified very fine to coarse gravel and fine to very coarse sand, with a few cobbles and a few lenses of well-sorted fine to medium sand; clasts are subangular to rounded, with light silt coatings.

3.5 m Slump Covered: Assumed to be material as above.

Maximum clast size in the pit area is 0.4 m. However, clasts exceeding 0.1 m in size are estimated to comprise less than 1% of the material.

This pit is in the western end of the Campobello kame moraine (see also B15-5, 103, 104, and 105), in the only portion of the western third of the moraine that lies outside of Roosevelt Campobello International Park. Reserves are estimated in two parts: A, for the pit area; and B, for the International Park area. Exposures in the latter area were limited to shallow, hand-dug excavations in the road cuts. Consequently, the reserve estimate has been kept very conservative. The material exposed in the road cuts varied from silty gravelly sand through to sandy gravel.

MECHANICAL ANALYSIS:

sieve	50mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	100.0	83.2	79.8	63.6	48.9	38.0	28.5	19.5	11.2	5.3	3.1

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 24%	Sound Lithotypes 76%
felsic intrusive 5; chert 4; mafic intrusive 2; mafic extrusive 2; sandstone 2; siltstone 2; shale 2; weathered 2; felsic extrusive 1; schist 1; slate 1	felsic intrusive 16; argillite 10; mafic extrusive 8; metasedimentary 8; quartzite 8; mafic intrusive 7; felsic extrusive 6; sandstone 3; metavolcanic 3; siltstone 2; dolomite 2; hornfels 2; quartz 1

ESTIMATION OF RESERVES:

	Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
A	9	5	3	150 000
B	210	150	2	3 million

LOCATION:	B15-7	**NTS:**	21 B/15
TYPE OF DEPOSIT:	Ice-contact	**COUNTY:**	Charlotte
EXPOSURE TYPE:	Pit	**PARISH:**	Campobello
STATUS:	Abandoned	**UTM:**	633 691

SECTION DESCRIPTION & COMMENTS:

West Face (Sample A)

0.5 m Soil: Silty soil, developed on the underlying material.

1.1 Cobbly Sandy Gravel: Poorly sorted, subhorizontally stratified, cobbly fine to very coarse gravel and medium to very coarse sand, with a few boulders; the upper 0.4 m is iron cemented; clasts are subangular to rounded, with light silt coatings.

7.4 m Slump Covered: Assumed to be sand and gravel.

East Face (Sample B)

0.5 m Soil: Slightly silty soil, developed in a sandy gravel bed.

2.0 m Sand: 1.4 m of fine to medium sand overlying 0.6 m of fine to coarse sand; the unit is subhorizontally stratified, with some trough cross-beds.

6.5 m Slump Covered: Assumed to be sand or gravel.

Maximum clast size in the pit area is 0.8 m. Clasts greater than 0.1 m in size are estimated to comprise approximately 5% of the total material.

(CONTINUED)

MECHANICAL ANALYSIS:

sieve	50mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass. A	81.9	64.2	57.9	44.8	34.8	27.6	18.6	8.4	4.9	3.0	1.7
B			100.0	99.8	99.5	98.0	92.9	76.5	44.9	14.9	3.2

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 22%	Sound Lithotypes 78%
mafic intrusive 6; weathered 6; felsic intrusive 3; shale 2; felsic extrusive 1; mafic extrusive 1; sandstone 1; siltstone 1; chert 1	mafic extrusive 17; mafic intrusive 13; felsic intrusive 12; argillite 9; felsic extrusive 7; metasedimentary 7; quartzite 6; sandstone 3; siltstone 1; greywacke 1; metavolcanic 1; gneiss 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
95	50	1	500 000

Location #: B15-7 **(cont'd)**

Two samples have also been obtained from this site by DOT (1985). The results of the tests on these samples were as follows:

Mechanical Analysis:
87 and 96% passing 50 mm
52 and 58% passing 4.75 mm
1.7 and 3.0% passing 75 um

Los Angeles abrasion loss: 19.7%

Recommended for use as borrow, subbase, and base-course aggregate.

This deposit is interpreted as a kame moraine segment. However, it may have been extensively reworked by marine waters. The material exposed in coastal sections is variable. At Southern Head, 5.4 m of cobbly sandy gravel of presumed ice-contact origin is exposed. Near Raccoon Point (B15-106), the material is primarily sand that may be of marine origin.

Reserves are estimated only for the southwestern part of the deposit, which lies outside of the 300 m shore area as designated under the Quarriable Substances Act. Since exposures are few and shallow in this area, the estimate is very conservative.

B15-102 UTM 636 730

This new pit has been developed in a pocket of material, probably ice-contact stratified drift, lying between knobs of outcrop. It exposes up to 4 m of horizontally stratified fine to coarse gravel and fine to medium sand, with a few cobbles and small boulders.

Similar small deposits may be present elsewhere in the area.

B15-103 UTM 623 720

This abandoned pit is approximately 8 to 10 m deep. The exposed material appears to be mainly sand, though some gravel is also present. DOT (1972) obtained three samples of fine aggregate and two samples of coarse aggregate from this site. Their test results were as follows:

Mechanical Analysis - fine aggregate
84 to 97% passing 4.75 mm (average 91%)
2.2 to 12.7% passing 75 um (average 6.4%)

- coarse aggregate
89 and 95% passing 50 mm
12 and 20% passing 4.75 mm
4.2 and 4.4% passing 75 um

Los Angeles abrasion loss: 17.4%

The coarse aggregate was recommended for use as borrow, subbase, and base-course aggregate; the fine aggregate for borrow, and as a possible source of blending and filter sand.

This pit is developed in the Campobello kame moraine (see also B15-5, 6, 104, and 105). Workable reserves in that part of the deposit lying to the north of Highway 774 are estimated to be in the order of 200 000 m^3.

B15-104 UTM 620 718

This inactive pit exposes about 1.5 to 7 m of primarily fine material, generally similar to that at B15-5 and B15-103. DOT (1980, 1985) obtained 9 samples from the pit area. The test results were as follows:

Mechanical Analysis:
94 to 100% passing 50 mm (average 98%)
60 to 86% passing 4.75 mm (average 76%)
4.1 to 15.3% passing 75 um (average 8.6%)

Los Angeles abrasion loss: 20.2 to 22.2% (average 20.9%)

No recommendations were made regarding the use of the material.

The abandoned pit immediately to the northeast of this site is deeper, but is otherwise similar.

The International Passamaquoddy Engineering Board (1959) presents the log of a test hole bored in this area. The hole, 14 m deep, exposed interbedded sandy gravel and sand, in approximately 3:2 ratio.

Workable reserves in that part of the Campobello kame moraine in the general area of the pit, bounded by Highway 774, Herring Cove Road, and the boundary of Campobello Provincial Park, are estimated to be in the order of 500 000 m^3.

B15-105 UTM 623 714

This largely abandoned pit in the Campobello kame moraine varies from about 1.5 to 4 m in depth. An intermittently active face at the northern end of the pit exposes approximately 1 m of sandy gravel overlying cross-bedded gravelly sand. DOT (1972, 1985) obtained 7 samples from the pit area, for which the test results were as follows:

Mechanical Analysis:
86 to 100% passing 50 mm (average 94%)
42 to 73% passing 4.75 mm (average 62%)
1.3 to 7.7% passing 75 um (average 3.5%)

Los Angeles abrasion loss: 17.5 to 18.6% (average 18.1%)

Recommended for borrow and subbase use only, due to poor grading.

The International Passamaquoddy Engineering Board (1959) reports the logs of three test holes bored in the general pit area. The two holes to the north of the pit, 5.8 and 8.2 m deep, exposed about 2 m of sandy gravel, overlying interbedded sand, silt and clay. The third hole, to the east of the pit, passed through 11.9 m of sand.

This pit is adjacent to Campobello Provincial Park. DOT (1979, 1985) tested two areas within the Park, to the north of the Glensevern Road. The results of the tests, on 11 samples from this area, were as follows:

Mechanical Analysis:
76 to 100% passing 50 mm (average 92%)
33 to 64% passing 4.75 mm (average 51%)
1.7 to 3.1% passing 75 um (average 2.4%)

Los Angeles abrasion loss: 16.3 to 17.9% (average 17.2%)

A sample crushed in the lab had 51% passing 4.75 mm, 2.4% passing 75 um, and soundness losses of 29.4% (stone) and 6.17% (sand). The material was recommended for use as borrow, subbase, base-course, and asphaltic concrete aggregate.

Potentially workable aggregate reserves in the Campobello kame moraine within Campobello Provincial Park, to the southwest of Herring Cove Road, are in the order of 1.5 million m^3.

B15-106 UTM 639 683

The coastal cliff at the southern end of Raccoon Beach exposes 14.3 m of granular material, mainly sand, with minor silty bands, and some cobbly sandy gravel horizons. This

material may be ice-contact stratified drift deposited directly in the sea. Alternatively, it may be material reworked from a moraine ridge by wave action.

Exploitation of such material lying within 300 m of the shore is not recommended.

B15-107

UTM 634 668

The cliff section at this site exposes the best stratigraphic section that has been observed on Campobello Island: 1.6 m of cobbly and bouldery sandy gravel overlying 8 or 9 m of dense sandy till that rests on bedrock striated by east-southeastward flowing ice. The thick till may form the core of the kame moraine to the north, and may lie close to the surface in parts of that deposit.

APPENDIX C

SITE DESCRIPTIONS

GRAND MANAN ISLAND

21 B/15, B/10

LOCATION:	B15-8	**NTS:**	21 B/15
TYPE OF DEPOSIT:	Glaciofluvial outwash	**COUNTY:**	Charlotte
EXPOSURE TYPE:	Pit	**PARISH:**	Grand Manan
STATUS:	Inactive	**UTM:**	754 619

SECTION DESCRIPTION & COMMENTS:

0.3 m Soil: Silty soil A-horizon, developed in a sandy gravel.

0.3 m Sand and Gravel: Oxidized, interbedded openwork very fine to fine gravel, and coarse to very coarse sand.

1.1 m Gravel: 0.4 m of oxidized very fine to very coarse gravel with a matrix of coarse to very coarse sand, over 0.7 m of unoxidized fine to very coarse gravel with a matrix of very fine to medium sand; subhorizontally stratified.

0.3 m Slump Covered: Assumed to be material as above; shattered basalt appears to be present at the base of the pit.

Clasts in this deposit are subangular to subrounded, with moderate to heavy silt coatings. Clasts exceeding 0.1 m in size are rare, but a few boulders up to 0.5 m in size are present.

DOT (1973) obtained three samples from this pit area for testing. The results were as follows:

(CONTINUED)

MECHANICAL ANALYSIS: Composite Sample

sieve	50mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	97.6	77.4	71.0	47.4	31.2	18.7	13.3	11.5	10.0	6.4	3.7

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 22%	Sound Lithotypes 78%
mafic extrusive 16; mafic intrusive 3; sandstone 1; shale 1; metavolcanic 1	mafic extrusive 58; mafic intrusive 9; felsic extrusive 3; felsic intrusive 2; sandstone 2; greywacke 2; argillite 1; quartzite 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
			Limited

Location #: B15-8 **(cont'd)**

Mechanical Analysis:
52 to 81% passing 50 mm (average 66%)
20 to 30% passing 4.75 mm (average 24%)
2.5 to 3.6% passing 75 um (average 2.9%)

Los Angeles abrasion loss: 18.1%

Recommended for use as borrow, subbase, base-course, and cover aggregate.

The boundaries of this deposit are unknown. It may be more or less extensive than as mapped. Test pitting would be required to determine its true extent. Reserves in the current pit area are limited.

LOCATION:	B15-9	**NTS:**	21 B/15
TYPE OF DEPOSIT:	Marine shallow-water	**COUNTY:**	Charlotte
EXPOSURE TYPE:	Pit	**PARISH:**	Grand Manan
STATUS:	Inactive	**UTM:**	781 598

SECTION DESCRIPTION & COMMENTS:

0.5 m Soil: Iron oxide cemented soil, developed in a sandy gravel.

0.5 m Gravel: Openwork medium to coarse gravel.

0.2 m Sand: Medium to very coarse sand.

0.3 m Gravel: Openwork fine to very coarse gravel.

0.9 m Sandy Gravel: Predominantly very fine to medium gravel and coarse to very coarse sand.

Clasts in this deposit are subangular to rounded, with light to moderate silt coatings. Many are platy. Maximum clast size is 0.4 m, but very few clasts exceed 0.1 m in size.

Bedrock is exposed at the surface just to the southeast of the pit. The abandoned pit to the southwest exposes 0 to 4.5 m of sandy gravel over an irregular bedrock surface.

MECHANICAL ANALYSIS: Composite Sample

sieve	50mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	100.0	97.6	94.2	62.6	35.9	14.8	4.4	1.4	0.8	0.7	0.5

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 32%	Sound Lithotypes 68%
mafic intrusive 6; shale 5; metasedimentary 5; weathered 4; metavolcanic 3; sandstone 2; chert 2; schist 2; felsic intrusive 1; mafic extrusive 1; siltstone 1	mafic intrusive 22; felsic intrusive 14; quartzite 11; mafic extrusive 4; greywacke 4; gneiss 4; felsic extrusive 2; argillite 2; metavolcanic 2; metasedimentary 2; siltstone 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
			Limited (nearing depletion)

LOCATION:	B15-10	**NTS:**	21 B/15
TYPE OF DEPOSIT:	Glaciofluvial outwash	**COUNTY:**	Charlotte
EXPOSURE TYPE:	Pit	**PARISH:**	Grand Manan
STATUS:	Active-on-demand	**UTM:**	763 587

SECTION DESCRIPTION & COMMENTS:

East Face (Sample A)

0.5 m Soil: Silty soil, developed on the underlying material.

2.0 m Sand and Gravel: Subhorizontally stratified, interbedded sand and sandy gravel; sand beds, comprising approximately 25% of the section, are medium to coarse, to gravelly coarse to very coarse; the sandy gravel beds vary from very fine to medium gravel, to medium to very coarse gravel with a few cobbles, both with predominantly medium to very coarse sand.

0.3 m Slump Covered: Assumed to be material as above.

West Face (Sample B)

0.5 m Soil: Slightly silty soil, developed on the underlying material.

0.8 m Sand and Gravel: Subhorizontally stratified, interbedded coarse to very coarse sand, openwork very fine to fine gravel, and minor openwork medium to coarse gravel.

1.3 m Gravel: Subhorizontally stratified, openwork gravel beds, ranging from very fine to medium, to medium to very coarse; includes minor thin sandy gravel beds.

(CONTINUED)

MECHANICAL ANALYSIS:

sieve	50mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass. A	96.6	75.2	70.2	59.8	50.0	36.9	20.7	6.2	2.0	1.5	1.3
B	100.0	82.8	69.7	43.5	22.2	7.1	2.7	1.4	1.1	0.9	0.7

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 19%	Sound Lithotypes 81%
mafic extrusive 10; mafic intrusive 2; shale 2; sandstone 1; siltstone 1; chert 1; slate 1; weathered 1	mafic extrusive 42; mafic intrusive 16; felsic intrusive 6; quartzite 5; sandstone 4; felsic extrusive 2; metasedimentary 2; siltstone 1; greywacke 1; argillite 1; metavolcanic 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
35	5	1.5	75 000

Location #: B15-10 **(cont'd)**

Clasts in this deposit are subangular to well-rounded, with heavy silt coatings. Maximum clast size is 0.6 m. However, clasts exceeding 0.1 m in size are estimated to comprise less than 1% of the material.

The other pits in this deposit expose material varying from sand through to sand and gravel as described above. Cultural developments inhibit major exploitation of this deposit, and essentially sterilize the adjacent shallow-water marine deposit.

B15-108 UTM 784 599

This inactive pit exposes 1 to 2 m of horizontally stratified angular gravel, overlying sound bedrock. Legget (1980) has described this material as a shattered argillite, formed as "the result of freezing and thawing under permafrost conditions adjacent to glacier fronts" (p. 443). In contrast, the abandoned pit to the north exposes 1 to 3 m of sandy gravel, locally cobbly, overlying a bedrock surface that is locally shattered.

LOCATION:	B10-1	**NTS:**	21 B/10
TYPE OF DEPOSIT:	Glaciofluvial outwash	**COUNTY:**	Charlotte
EXPOSURE TYPE:	Shore cliff	**PARISH:**	Grand Manan
STATUS:	Undeveloped	**UTM:**	670 403

SECTION DESCRIPTION & COMMENTS:

0.7 m Soil: Silty soil, developed on the underlying material.

0.8 m Cobbly Gravel: Subhorizontally stratified, interbedded openwork gravel and sandy gravel; the gravel component is very fine to very coarse and cobbly; the sand component is coarse to very coarse; clasts are angular to rounded, with moderate silt coatings and extensive manganese oxide coatings; 2 to 5% of the material is estimated to consist of clasts exceeding 0.1 m in size.

6.6 m Slump Covered: Assumed to be sand or gravel; if this deposit is an outwash delta, the material could be finer than that above.

The thickness of this deposit varies from about 2.5 m to 8.5 m, over basalt bedrock. Some very large boulders, up to 2.5 m in size, along the shoreline were presumably derived from this deposit.

Reserves are calculated only for the portion of the deposit lying more than 300 m from the shore.

MECHANICAL ANALYSIS:

sieve	50mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	71.8	53.7	52.7	36.5	28.6	18.4	9.6	6.7	5.1	3.6	2.1

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 32%	Sound Lithotypes 68%
mafic intrusive 12; weathered 4; felsic intrusive 3; shale 3; schist 3; slate 3; chert 2; felsic extrusive 1; siltstone 1	mafic intrusive 18; mafic extrusive 9; felsic extrusive 7; felsic intrusive 6; greywacke 5; quartzite 5; sandstone 4; argillite 4; siltstone 3; metavolcanic 3; metasedimentary 3; quartz 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
10	2	2	40 000

LOCATION:	B10-2	**NTS:**	21 B/10
TYPE OF DEPOSIT:	Glaciofluvial outwash	**COUNTY:**	Charlotte
EXPOSURE TYPE:	Road cut	**PARISH:**	Grand Manan
STATUS:	Undeveloped	**UTM:**	684 425

SECTION DESCRIPTION & COMMENTS:

0.5 m Soil: Silty soil, developed on the underlying material.

1.5 m Sandy Gravel: Subhorizontally stratified very fine to very coarse gravel and medium to coarse sand, with a few cobbles, and minor thin sand beds; clasts are subangular to rounded, with light to moderate silt coatings; maximum clast size is 0.2 m, but very few clasts exceed 0.1 m in size.

0.3 m Slump Covered: Assumed to be material as above.

Legget (1980) described organic sediments in a stream cut section to the north along Deep Cove Brook. From his description, and from the appearance of the area on the aerial photographs, the Deep Cove Brook valley (extending about 2 km north of the highway) may have been a lacustrine or estuarine basin. More gravelly deposits may be scattered through this area.

MECHANICAL ANALYSIS:

sieve	50mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	100.0	84.3	79.5	70.2	60.3	51.6	43.5	30.8	8.6	1.4	0.9

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 29%	Sound Lithotypes 71%
mafic intrusive 11; mafic extrusive 7; weathered 4; shale 3; schist 2; chert 1; slate 1	mafic intrusive 24; mafic extrusive 15; quartzite 9; felsic intrusive 5; siltstone 4; felsic extrusive 3; argillite 3; metasedimentary 3; sandstone 2; greywacke 1; gneiss 1; quartz 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
9	3	1.5	45 000

LOCATION:	B10-3	**NTS:**	21 B/10
TYPE OF DEPOSIT:	Glaciofluvial outwash	**COUNTY:**	Charlotte
EXPOSURE TYPE:	Pit	**PARISH:**	Grand Manan
STATUS:	Inactive	**UTM:**	736 483

SECTION DESCRIPTION & COMMENTS:

0.5 m Soil: Slightly silty soil, developed on the underlying material.

1.0 m Sand and Gravel: Subhorizontally stratified, interbedded medium to coarse sand, gravelly coarse to very coarse sand, and sandy very fine to coarse gravel.

1.0 m Cobbly Sandy Gravel: Subhorizontally stratified, cobbly medium to very coarse gravel and medium to very coarse sand.

0.3 m Slump Covered: Assumed to be material as above; a weathered, undulating basalt surface outcrops locally on the pit floor.

Clasts in this deposit are subangular to rounded, with moderate to heavy silt coatings. A number of large boulders, up to 2.5 m in size, are present in the pit area. Clasts exceeding 0.1 m in size are estimated to comprise about 5% of the material.

This pit has been sampled by DOT (1973, 1985). The results of the tests, on four samples, are as follows:

Mechanical Analysis
58 to 78% passing 50 mm (average 69%)

(CONTINUED

MECHANICAL ANALYSIS: Composite Sample

sieve	100mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	89.2	60.3	56.3	47.7	38.4	25.3	13.6	5.1	3.4	2.5	1.5

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 33%	Sound Lithotypes 67%
mafic intrusive 18; mafic extrusive 7; shale 3; weathered 2; felsic intrusive 1; chert 1; metavolcanic 1	mafic intrusive 36; mafic extrusive 12; felsic extrusive 5; sandstone 4; quartzite 4; felsic intrusive 1; siltstone 1; greywacke 1; argillite 1; metavolcanic 1; gneiss 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
36	12	1.5	180 000

Location #: B10-3 (cont'd)

28 to 44% passing 4.75 mm (average 35%)
1.1 to 4.6% passing 75 um (average 2.4%)

Los Angeles abrasion loss: 17.6 to 33.6% average (25.6%)

Recommended for use as borrow and subbase aggregate. The material with a low abrasion loss was also recommended for use as base-course and cover aggregate.

This pit is very large, and has several inactive to active-on-demand faces. However, most of the pit area is abandoned, and used in part for dumping. Most of the remaining reserves in this deposit lie in The Anchorage Provincial Park.

LOCATION:	B10-4	**NTS:**	21 B/10
TYPE OF DEPOSIT:	Marine shallow-water	**COUNTY:**	Charlotte
EXPOSURE TYPE:	Pit	**PARISH:**	Grand Manan
STATUS:	Active-on-demand	**UTM:**	742 481

SECTION DESCRIPTION & COMMENTS:

0.2 m Soil: Silty soil A-horizon, developed on the underlying material.

0.5 m Sandy Gravel: Fine to coarse gravel and medium to very coarse sand.

0.3 m Sand and Gravel: Interbedded medium to very coarse sand, and openwork very fine to medium gravel.

0.5 m Gravelly Sand: Medium to very coarse sand and very fine to medium gravel; saturated (water was seeping out of the base of the section, which is presumably close to the bedrock surface).

Clasts in this deposit are subangular to rounded, with light to moderate silt coatings. Maximum clast size is 0.6 m, but clasts exceeding 0.1 m in size are extremely rare.

The above section is at the eastern end of a large, shallow, pit area. Faces are typically 1 to 1.5 m, locally 2 m, high. DOT (1985) test pitting in the area indicates an average workable thickness in the deposit of 1.3 m (to bedrock or the water table).

The results of DOT's (1985) tests on 5 samples of the material were as follows:

(CONTINUED)

MECHANICAL ANALYSIS: Composite Sample

sieve	50mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	100.0	96.6	92.5	82.7	63.4	45.8	29.8	15.9	6.0	3.3	1.6

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 46%	Sound Lithotypes 54%
mafic intrusive 19; weathered 11; shale 8; mafic extrusive 6; sandstone 2	mafic intrusive 10; felsic intrusive 8; siltstone 8; quartzite 8; felsic extrusive 4; sandstone 4; greywacke 4; argillite 4; metavolcanic 2; metasedimentary 2

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
390	100	1	1.0 million

Location #: B10-4 **(cont'd)**

Mechanical Analysis:
66 to 98% passing 50 mm (average 86%)
34 to 50% passing 4.75 mm (average 42%)
3.1 to 4.2% passing 75 um (average 3.5%)

Los Angeles abrasion loss: 31.2 to 35.2% average (33.2%)

Recommended for use as borrow, subbase, and base-course aggregate.

Reserves are estimated for that part of the marine shallow-water deposit to the southwest of Grand Brook. That part of the area lying within 300 m of the shoreline was not included in the reserve estimate. Extraction activities in this area will be hindered by the generally shallow depths to bedrock or the water table.

LOCATION:	B10-5	**NTS:**	21 B/10
TYPE OF DEPOSIT:	Glaciofluvial outwash	**COUNTY:**	Charlotte
EXPOSURE TYPE:	Pit	**PARISH:**	Grand Manan
STATUS:	Active-on-demand	**UTM:**	748 501

SECTION DESCRIPTION & COMMENTS:

0.5 m Soil: Silty soil, developed on the underlying material.

2.3 m Sand and Gravel: Subhorizontally stratified, interbedded sands and gravels; the beds vary from clean coarse to very coarse sand, through openwork very fine to fine gravel and openwork fine to very coarse gravel, to sandy fine to very coarse gravel; clasts are subrounded to well-rounded, with moderate to heavy silt coatings; the unit is partially cemented by iron and manganese oxides.

0.9 m Slump Covered: Assumed to be material as above; basalt outcrops locally at the base of the pit.

Sections in the pit area range from about 2 to 4 m. Most of the pit is abandoned and overgrown. A few erratics up to 0.7 m in size are locally present, but clasts exceeding 0.1 m in size are very rare.

Three samples have been obtained from the pit area by DOT (1973, 1985). The results of the tests are as follows:

(CONTINUED)

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.		88.7	81.5	64.4	48.9	26.8	15.4	9.0	5.2	3.6	1.8

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 28%	Sound Lithotypes 72%
mafic intrusive 14; mafic extrusive 3; felsic intrusive 2; chert 2; schist 2; weathered 2; felsic extrusive 1; shale 1; slate 1	mafic intrusive 28; mafic extrusive 14; felsic intrusive 7; quartzite 6; sandstone 4; argillite 3; metavolcanic 2; metasedimentary 2; quartz 2; felsic extrusive 1; siltstone 1; greywacke 1; gneiss 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
22	4 (nearing depletion)	2	80 000

Location #: B10-5 **(cont'd)**

Mechanical Analysis:
68 to 100% passing 50 mm (average 86%)
30 to 49% passing 4.75 mm (average 41%)
1.8 to 11.6% passing 75 um (average 5.1%)

Los Angeles abrasion loss: 24.1 to 34.5% (average 29.3%)

Recommended for use as borrow, and possibly as subbase and base-course aggregate.

The reserve estimate pertains to that part of the outwash deposit to the southwest of Grand Brook. See B10-107 for details concerning the part to the northeast of the brook.

LOCATION:	B10-6	**NTS:**	21 B/10
TYPE OF DEPOSIT:	Glaciofluvial outwash	**COUNTY:**	Charlotte
EXPOSURE TYPE:	Pit	**PARISH:**	Grand Manan
STATUS:	Abandoned	**UTM:**	757 556

SECTION DESCRIPTION & COMMENTS:

0.5 m Soil: Silty soil; developed on the underlying material.

1.8 m Cobbly Sandy Gravel: Crudely stratified, cobbly medium to very coarse gravel and medium to very coarse sand; clasts are subangular to rounded, with heavy silt coatings; clasts exceeding 0.1 m in size are estimated to comprise 5 to 10% of the material; maximum clast size is 0.7 m.

1.9 m Slump Covered: Assumed to be material as above; the base of the pit is wet, and presumably close to the bedrock surface.

Two samples were obtained from the pit area by DOT (1973). The results of the tests on these samples are as follows:

Mechanical Analysis:
54 and 68% passing 50 mm
27 and 34% passing 4.75 mm
0.7 and 2.6% passing 75 um

Los Angeles abrasion loss: 28.5%

Recommended for use as borrow, subbase, and base-course material.

Development of this deposit is inhibited by the presence of the road, and Mill Brook and its tributaries.

MECHANICAL ANALYSIS:

sieve	50mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	58.5	48.8	45.4	39.4	36.1	30.1	23.8	14.2	6.2	3.8	3.0

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 33%	Sound Lithotypes 67%
mafic intrusive 21; weathered 5; felsic intrusive 2; chert 2; felsic extrusive 1; mafic extrusive 1; conglomerate 1	mafic intrusive 45; mafic extrusive 5; felsic intrusive 4; felsic extrusive 4; quartzite 4; conglomerate 1; sandstone 1; argillite 1; metavolcanic 1; gneiss 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
26	5	3	150 000

LOCATION:	B10-7	NTS:	21 B/10
TYPE OF DEPOSIT:	Marine shallow-water	COUNTY:	Charlotte
EXPOSURE TYPE:	Pit	PARISH:	Grand Manan
STATUS:	Abandoned	UTM:	759 516

SECTION DESCRIPTION & COMMENTS:

0.3 m Soil: Slightly silty and gravelly soil A-horizon, developed on the underlying material.

1.9 m Sand: Dense, massive medium to very coarse sand; the upper 0.8 m is oxidized (soil (B-horizon); two thin layers of very fine to fine gravel are present near the base; free water is present at the base.

The sections in this pit expose very little gravel. However, the base of the pit is covered with sandy gravel, locally cobbly. The gravel presumably underlies the sand. A few erratics up to 0.7 m in size are present in the pit area.

One sample of gravelly sand from this pit has been tested by DOT (1973). The mechanical analysis results were: 72% passing 4.75 mm, and 0.9% passing 75 um. The material was recommended for use as borrow, and as blending and winter sand.

The reserve estimate pertains to the area of shallow-water marine deposits lying to the west of Bald Heath and Bleumortier Brook, and extending from Grand Brook to the coast north of Castalia. Observations indicate that the material in this area varies from sand, as above, to cobbly sandy gravel. Sandy gravel appears to be predominant. Extraction activities in this area will be generally hindered by the shallow depth to bedrock or the water table.

MECHANICAL ANALYSIS:

sieve		25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.			100.0	99.4	98.3	95.4	74.8	28.3	3.7	2.7	2.1

LITHOLOGIC ANALYSIS: N.A.

Unsound Lithotypes	%	Sound Lithotypes	%

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
650	250	1	2.5 million

LOCATION:	B10-8	**NTS:**	21 B/10
TYPE OF DEPOSIT:	Marine shallow-water	**COUNTY:**	Charlotte
EXPOSURE TYPE:	Pit	**PARISH:**	Grand Manan
STATUS:	Active-on-demand	**UTM:**	778 520

SECTION DESCRIPTION & COMMENTS:

0.6 m Soil: Silty soil, developed on the underlying material.

1.2 m Cobbly Sandy Gravel: Crudely stratified, cobbly very fine to very coarse gravel and medium to very coarse sand; clasts are subangular to rounded, with moderate silt coatings; clasts exceeding 0.1 m in size are estimated to comprise 2 to 5% of the material.

0.8 m Slump Covered: Assumed to be material as above.

Maximum clast size in the pit area is 0.8 m. The base of the pit is bedrock (metasediments), forming an undulatory surface. The thickness of the material varies from less than 0.5 m up to 2.6 m.

The reserve estimate pertains to the shallow-water marine deposits lying to the east of Bald Heath and Bleumortier Brook, and extending from Grand Harbour to Castalia Marsh. Extraction activities in this area will be generally hindered by the shallow depth to bedrock or the water table.

MECHANICAL ANALYSIS:

sieve	50mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	62.6	45.0	40.6	33.6	28.2	23.1	15.3	6.7	2.6	1.6	1.1

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 21%	Sound Lithotypes 79%
mafic intrusive 7; weathered 6; mafic extrusive 3; shale 3; felsic intrusive 1; sandstone 1	mafic intrusive 31; felsic intrusive 10; mafic extrusive 9; felsic extrusive 6; quartzite 6; metasedimentary 5; argillite 4; greywacke 2; metavolcanic 2; quartz 2; sandstone 1; gneiss 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
350	130	1	1.3 million

LOCATION:	B10-9	**NTS:**	21 B/10
TYPE OF DEPOSIT:	Marine shallow-water	**COUNTY:**	Charlotte
EXPOSURE TYPE:	Pit	**PARISH:**	Grand Manan
STATUS:	Abandoned	**UTM:**	828 451

SECTION DESCRIPTION & COMMENTS:

0.5 m Soil: Silty soil, developed on the underlying material.

0.5 m Sandy Gravel: Very fine to medium gravel and coarse to very coarse sand.

0.5 m Gravel: Slightly cobbly, openwork fine to coarse gravel.

1.9 m Slump Covered: Assumed to be material as above, but possibly coarser (many cobbles, and boulders up to 0.6 m in size, are present on the pit floor).

The clasts in this deposit are subrounded to rounded, with moderate silt coatings. Many are platy.

The base of the pit lies on an undulating, polished metavolcanic bedrock surface. The thickness of the overlying material varies from virtually nil to a maximum of about 6 m adjacent to the cemetery. The remaining volume of workable material is largely constrained by cultural developments.

MECHANICAL ANALYSIS: Composite Sample

sieve	50mm	25mm	19mm	9.5mm	4.75mm	2.36mm	1.18mm	600um	300um	150um	75um
% pass.	92.3	83.8	78.8	65.7	40.4	21.7	7.4	2.5	1.9	1.5	1.2

LITHOLOGIC ANALYSIS:

Unsound Lithotypes 24%	Sound Lithotypes 76%
weathered 8; shale 5; schist 3; felsic extrusive 2; chert 2; slate 2; sandstone 1; siltstone 1	felsic extrusive 14; mafic intrusive 11; mafic extrusive 10; felsic intrusive 9; quartz 8; quartzite 6; sandstone 4; greywacke 3; argillite 3; metasedimentary 3; siltstone 1; metavolcanic 2; gneiss 1

ESTIMATION OF RESERVES:

Total Deposit Area (hectares)	Area Workable (hectares)	Average Thickness (metres)	Recoverable Reserves (m^3) Probable
26	2	2	40 000

B10-101 UTM 683 418

The shore section at this point exposes approximately 1.5 m of cobbly sandy gravel overlying approximately 2 m of very dense reddish brown till, that in turn overlies basalt bedrock. The gravel is presumed to be of marine shoreline origin. Further to the south it directly overlies the bedrock. It is probably thin throughout, and this, combined with its proximity to the shore, severely limits its potential as a source of aggregate.

B10-102 UTM 695 470

This small, active-on-demand quarry exposes 2 to 3 m of weathered basalt. Throughout most of the quarry, the basalt extends to the surface. However, in the north face there is an apparently local occurrence of approximately 1.5 m of sandy gravel overlying a dense, reddish brown silty till.

B10-103 UTM 701 463

The south face of this abandoned hillside quarry exposes up to 2 m of colluvium, composed of angular basalt clasts, overlying up to 3 m of dense, silty stony till that in turn overlies solid basalt. However, most of the quarry appears to have been excavated, to depths of 2 to 4 m, in weathered basalt.

B10-104 UTM 714 567

This tiny, long abandoned pit (now a playground) exposes 2 to 3 m of very coarse cobbly gravel. The deposit may be a small outwash delta. Workable reserves are probably very limited.

Bailey (1871) indicates that the low terrace on which these sediments lie is underlain by soft Triassic redbed sandstones.

B10-105 UTM 718 563

This site is a road cut exposure of columnar basalt. Columnar blocks of material obtained from this section have seen local use for driveway edging, construction of retaining walls, etc.

B10-106 UTM 730 460

This site is a long abandoned and thoroughly overgrown pit. The few remaining sections expose 1 to 1.5 m of relatively fine sandy gravel. Legget (1980) indicates that this material overlies bedrock or up to two different tills. Marine shells from this gravel have been dated at 13 000±330 yBP (GSC-2777; Legget 1980).

The pit area is essentially depleted. The deposit area extending northeastward to The Anchorage Provincial Park lies within the 300 m designated shore area under the Quarriable Substances Act. Extraction of material from this area is not recommended.

B10-107 UTM 751 505

This active-on-demand pit, at the north end of an extensive pit complex, exposes 2 to 4 m of cobbly sandy gravel, similar to that at B10-6, and much coarser than that at B10-5. Two samples were obtained from this area by DOT (1973). The tests results on these samples are as follows:

Mechanical Analysis:
42 and 68% passing 50 mm
20 and 34% passing 4.75 mm
1.0 and 2.8% passing 75 um

Los Angeles abrasion loss: 31.0%

Recommended for use as borrow, subbase, and base-course material.

An asphalt plant is currently operational in this pit. Remaining reserves of crushable material, in the part of the deposit to the north of the pit, are estimated to be in the order of 50 000 m^3. The southern part of the pit complex, currently abandoned, is very sandy. A limited volume of fine aggregate may remain in this area.

B10-108 UTM 759 516

This abandoned, cliff-face quarry exposes approximately 10 to 15 m of columnar basalt. DOT (1973) indicates that the material from this quarry has a low Los Angeles abrasion loss of 16.8%.

B10-109 UTM 766 556

This shallow, inactive to abandoned quarry has been developed in shattered metasedimentary rocks that underlie a thin veneer of shallow-water marine sediments. DOT (1973) reports a Los Angeles abrasion loss of 22.5% for material from this site.

B10-110 UTM 830 439

This small pit was developed in a small beach deposit that is virtually surrounded by surface outcrops. Ferruginous and manganiferous cobbly sandy gravel, from 0.5 to 1.5 m thick, overlies a polished bedrock surface. This deposit is essentially depleted, but similar small deposits may be present elsewhere on White Head Island, or the other islands in the Grand Manan archipelago.

MAPS
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